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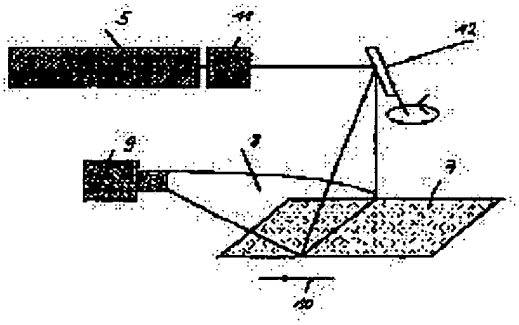
(54) METHOD FOR READING OUT IMAGE OF LIGHT AND SYSTEM THEREFOR

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain high sharpness.
SOLUTION: An image of light previously stored in a screen 7 of a photo-stimulable phosphor containing a cesium halide activated with divalent europium is read out. The halide is at least one of chloride and bromide. The screen 7 is scanned with a spot of laser light having <100 μm diameter.



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CLAIMS

[Claim(s)]
[Claim 1] In the method of reading the picture of the light saved on the screen of a phosphor which can be stimulated with light - It Scans by Stimulus Light to which this Screen was Emitted by Laser Light Source. - Light Emitted by this Screen in response to Stimulus is Detected, and it is -. It Consists of Process in Which Detected Light is Changed into Electrical Signal Expression of Picture of this Light. - Screen of Phosphor Which Can be Stimulated with Light Consists of Phosphor of Halogenation Caesium by Which Activation was Carried Out with Divalent Europium. This halogenide is at least one sort of a chloride and a bromide. - Method characterized by doubling the focus of this laser beam so that the diameter of the laser spot emitted from this laser may measure between 1 of the profile of the shape of a gauss of this laser beam / point of e2 and may become smaller than 100 micrometers.
[Claim 2] In the optical picture read-out equipment for reading the picture of the light saved on the screen of a phosphor which can be stimulated with light - Light Source of Light Which Gives Stimulus, - Equipment with which Focus of Light Emitted by Light Source of Light Which Gives this Stimulus is Doubled, - Equipment toward which the Direction of Light Emitted by Light Source of Light Which Gives this Stimulus is Biased, - Light Emitted by Light Source of Light Which Gives this Stimulus by the Ability Giving Stimulus is Detected. The equipment which changes the light emitted by the ability giving this stimulus to electrical signal expression is provided. - Screen of this Phosphor Contains Halogenation Caesium by Which Activation was Carried Out with Divalent Europium. This halogenide is at least one sort of a chloride or a bromide, and is -. The equipment with which the focus of the light emitted by the light source of the light which gives a stimulus is doubled Optical picture read-out equipment characterized by being arranged so that the diameter of the spot of the beam of the light emitted by the light source of the light which gives a stimulus may measure between 1 of the profile of the shape of a gauss of this beam / point of e2 and may become smaller than 100 micrometers.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention relates to the method and system which read the picture of the light saved in the screen of a phosphor which can be stimulated with light.
[0002]
Background of the Invention] The optical image recording system which records the picture of light on the screen of a phosphor which can be stimulated with light is widely used today by exposing a screen to the transmitted light line modulated according to the picture.
[0003] The recorded picture is reproduced by detecting the light which stimulated the screen with which the phosphor which can be stimulated with light was exposed with the beam of light for a stimulus, was stimulated and was emitted from the screen of a phosphor, and changing the detected light into electrical signal expression of the picture of light.
[0004] In some application like the udder X-ray taking-a photograph method, the clearness of a picture is a very important parameter.
[0005] The clearness of the picture read from the screen of a phosphor which can be stimulated with light is dependent not only on own visibility and own resolution of a screen but the resolution obtained by the read-out system to be used.
[0006] In the usual read-out system used now, the premature start spot (flying spot) type scanning unit is usually used. Such a scanning unit contains the light source of stimulus light, for example, a laser light source, the equipment which scans the screen top of a phosphor which the direction of the light emitted by laser is biased and can be stimulated with light, and the optical equipment which makes the focus of a laser beam connect on a screen.
[0007] In the example of such a system, they are the registered trademarks [ADC and Agfa] 70. There is a diagnostic system of Agfa named Compact. In these systems, the screen of a phosphor which can be stimulated with the light containing a BaFBr:Eu phosphor is usually used.
[0008] The resolution of this read-out equipment is mainly determined by the size of the spot of a laser beam. It depends for the size of this spot on the property of the optical arrangement to which the focus of light is made to connect.
[0009] Optimization of the resolution of a scanning system knows that loss of the efficiency which carries out the uptake of the light of the optical system for doubling a focus will take place. The important portion of a laser beam stops connecting a focus on the screen of a picture as a result.
[0010] A big prejudice is leaning to the efficiency which carries out the uptake of the light of the optical system for doubling a focus using a system smaller than 50%. In these systems, it is because it is thought that the output of the suitable amount for fully reading this screen is not sent out to a screen within a permissible scan time.
[0011] For example, in order to be able to carry out read-out of a screen to sufficient grade for within a time [rational] in the case of a BaFBr:Eu phosphor, at least 15mW output is required on a screen.
[0012] Probably, there is no collection efficiency of light with a bird clapper more greatly than 50% for loss in the place of the mirror used for the reflection which takes place in the place of this optical element though all the light emitted from laser is caught by the optical system for focusing, and this system.
[0013] In the scanning system which catches a laser beam only less than [50% or it], the collection efficiency of light falls to 25%, therefore uses powerful laser rather than 60mW.
[0014] It is necessary to compensate this demand by the demand to making a radiation zone small.
[0015] It is difficult to solve both both demands by the cheap solution.
[0016]
[Objects of the Invention] The purpose of this invention is offering the method and system which read the picture of the light saved on the screen of a phosphor which can be stimulated with light.
[0017] Other purposes of this invention are offering such a method and a system that give high visibility.
[0018]
[Summary of the Invention] The above-mentioned purpose is attained by the method of patent claim claim 1 publication.
[0019] Other modes of this invention are indicated by the patent claim claim 6.
[0020] The specific feature of the example of suitable embodiment of this invention is indicated in the place of the main features of this invention of this specification tail, and a mode.

[0021] the halogenation caesium phosphor by which activation was carried out with divalent europium when following this invention -- containing -- this halogenide -- a chloride and a bromide -- the screen whose number is one even if few is used The focus of a laser beam used for stimulating this screen is doubled, and it is made for the diameter of the laser spot which measures between 1 of the profile of the gauss type of a laser beam / point of e2, and is emitted by this laser to become for it to be more desirable than 100 micrometers and smaller than 50 micrometers.
[0022] According to this invention, the solution over the problem of the conventional method stated to the beginning of this specification is offered.
[0023] If the halogenation caesium phosphor by which activation was carried out with divalent europium is used, the collection efficiency of light can use the low optical system for focusing.
[0024] A scanning unit can be optimized so that the size of the laser spot on the screen of a phosphor may become small by this method, and a system with high resolution can be obtained.
[0025] Since the halogenation caesium phosphor by which activation was carried out with divalent europium has the stimulus property of a from the first very good light, loss of the optical efficiency which originates in a measuring method and often happens is permissible by making the size of a laser spot small. The quality of the overall picture from which loss of the optical efficiency which often happens is acquired by this optical picture read-out system is not spoiled, and does not give the effect of minus to the overall throughput of a system.
[0026] This halogenide is at least one sort of a chloride and a bromide here including the halogenation caesium phosphor to which activation of the screen of a phosphor which can be stimulated with the light used for this invention was carried out with divalent europium.
[0027] Such a phosphor is well-known in this industry, for example, is indicated by the European Patent A-No. (and U.S. JP,5,028,509,B) 174875. This phosphor is suitable for especially manufacture of the screen of a phosphor "without cement." The screen of a phosphor without cement gives the optimal visibility.
[0028] However, it is also advantageous to use the thing showing the halogenide chosen from the group to which X changes from Br and Cl by the CsX:Eu phosphor. This is obtained by the following methods.
[0029] - EuX'2 and 10-3-5 mol % of EuX europium compounds chosen from the group which consists of '3 and EuOX' are mixed with CsX. X' is chosen from the group which consists of F, Cl, Br, and I here.
[0030] - It calcinates at temperature higher than 450 degrees C.
[0031] - This mixture is cooled.
[0032] - CsX:Eu phosphors are collected.
[0033] Compared with the halogenation caesium phosphor by which activation was carried out, the conversion efficiency of light is increasing the phosphorus obtained according to the above-mentioned manufacturing method to this industry with well-known divalent europium. This phosphor can be stimulated by the little stimulus luminous energy.
[0034] As for the screen of a phosphor which can be stimulated with the light which uses such a phosphor, obtaining by the following method is desirable.
[0035] - This CsX:Eu phosphor is built by calcinating EuX'2, and 10-3-5 mol the mixture of % and CsX of EuX europium compounds chosen from the group which consists of '3 and EuOX'. X' is chosen from the group which consists of F, Cl, Br, and I here.
[0036] - This phosphor is covered with the method chosen from the group which consists of a physical vapor deposition, a thermal vacuum deposition, a chemical vapor deposition, RF precipitator method, and pulse laser precipitator method to a substrate.
[0037] Since a phosphor carries out the deposition of this manufacturing method in the form of needle crystal by this, it is advantageous. The crystal of these needlelike phosphors acts as optical guidance, and it decreases that light spreads horizontally in the layer of a phosphor. If that light spreads to a longitudinal direction decreases, the image of high resolution will be obtained.
[0038] The screen of the phosphor containing the phosphorus which can be stimulated by the light of CsX:Eu as an exception method can be manufactured according to the following process. However, X expresses the halogenide chosen from the group which consists of Br and Cl.
[0039] - The multiplex container of this CsX and the europium compound chosen from the group which consists of EuX'2, EuX'3, and EuOX' is put on the bottom of a vacuum evaporationo condition. X' is chosen from the group which consists of F, Cl, Br, and I here.
[0040] - It carries out self-possessed [of both these CsX(s) and europium compounds] on a substrate at a rate which the CaX phosphor doped with % of the 10-3-5-mol europium compound produces on a substrate by the method chosen from the group which consists of a physical vapor deposition, a thermal vacuum deposition, a chemical vapor deposition, electron beam precipitator method, RF precipitator method, and pulse laser precipitator method.
[0041] Since a phosphor carries out the deposition also of this manufacturing method in the form of a needlelike crystal, it is advantageous. The phosphor of such needle crystal acts as optical guidance, and it decreases that light spreads horizontally in the layer of a phosphor. If that light spreads to a longitudinal direction decreases, the image of high resolution will be obtained.
[0042] The above-mentioned phosphor and the manufacturing method of a screen are indicated by the U.S. patent temporary application specification 60/No. 159,004 and No. 60/142,276. These specifications are appended for reference.
[0043] Other advantages and examples of embodiment of this invention will become clear from the following explanation and an accompanying drawing.

[0044]
[Detailed Description of the Invention] The performance of a certain system is usually shown by the SWR value. An SWR value shows attenuation of the square wave by this system. The amplitude of very low frequency (pair of 0.025 lines per mm) is taken as 100% of a reference point.
[0045] The digital system of most which used as the base the phosphor which may be stimulated by light like BaFBr:Eu shows the SWR value of 0.15-0.20 to the pair (3 lp/mm) of three lines per mm.
[0046] An SWR value is 3 also by the case of the screen of a very thin high resolution. 0.25 is not exceeded in a lp/mm place.
[0047] By the application to the system of udder roentgenography, an SWR value is 3. You must be about 0.5 in a lp/mm place.
[0048] A focus is acquired only for a case by having been united until the diameter of the spot of a laser beam becomes a very small value and these SWR values become less than [50 micrometers or it] typically. (This diameter is measured between 1 of the profile of the gauss type of a laser beam / point of e2.)
Since reduction of the diameter of a laser spot brings about reduction of a laser output in the place which scans the screen of a phosphor which a laser spot can stimulate with light, it explains below the fact that prejudice exists to reduction of the diameter of such a laser screen. Although reduction of such a laser output produces the need of lengthening a scan time, the energy saved on the screen of a phosphor which this gives the effect of minus to system throughput, or can be stimulated with light brings a result which is not emitted insufficiently.
[0049] This fact is explained with reference to the usual premature start spot scanning system. In this case, laser diode is used as the light source which stimulates the screen (system of a conventional method) of a BaFBr:Eu phosphor. The direction of a laser beam is biased using an ammeter with a mirror, or the rotating polygonal mirror.
[0050] When the spot which was able to double the focus is standing it still, when not using it for a scan, and when the distance from the lens for doubling a focus to a focus is small, it is easy to double the focus of a laser beam so that the spot of a small diameter may be obtained.
[0051] However, in the case of a premature start spot scanner, in accordance with 400mm distance (distance of the scanning line), the direction of a beam is biased typically. An ammeter with a mirror for biasing the laser beam of the direction of the scanning line or the rotating polygonal mirror is used. The beam for a scan is [about]. -It is biased within the angle of 20 degrees - +20 degrees (this angle is called angle theta).
[0052] For this reason, the length of the scanning line ls is determined by the distance (distance b) and angle theta to the screen of a phosphor which can be stimulated with light from an ammeter.
[0053] The following formula is materialized. (Please refer to drawing 1 again.)
[0054]
[Equation 1]

$$Ls < 2 * b * tg(2\theta)$$

または

$$b > \frac{Ls}{2 * tg(2\theta)}$$

$$b > \frac{400}{2 * tg(2\theta)} = 549{,}5mm$$

[0055] In order to obtain the scanning line with a length of 400mm, the distance to a screen must be longer than about 550mm.
[0056] Between the lens for doubling especially a focus, and the screen to of a phosphor which can be stimulated with light, at least 600mm distance is required.
[0057] Furthermore, you have to take into consideration doubling the focus of a laser beam with a lens. If the formula of classic optics is used, the optical collection efficiency and the optical maximum radiation zone permitted of optical equipment for doubling this focus are calculable as a function of the optical parameter of the lens used.
[0058] The following formula can be used when doubling a focus using a single lens.
[0059] The size (Lf) of the spot in the radiation zone (Le) and focus of laser is given by the following formula.
[0060]
[Equation 2]

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{b}$$

および

$$Le = Lf * \frac{v}{b}$$

[0061] b is larger than 600mm as a practical question (refer to above).
[0062] Optical transmittance is determined by the diameter of a lens, and the emissivity (divergence) of laser.

[0063] When considering the system which uses diode laser, these diode laser must take into consideration that emission (10 degrees and 30 degrees) is usually shown by astigmatism.
[0064] In order to obtain a good modulation transfer function (modulation trnasfer function, MTF), a lens is usually limited to the diameter of about 30mm. In order to collect all light at the angle of 30 degrees in the interior of a 30mm lens, maximum distance'v' is 15/(tg 30 degree), i.e., 26mm.
[0065] Lf is already determined from the 50-micrometer diameter at the maximum equator.
[0066] The highest radiation zone is calculable as follows.
[0067]
[Equation 3]

$$Le = Lf * \frac{v}{b}$$

$$Le = 50 * \frac{26}{600} = 2.17 \mu m$$

[0068] This is below the limitation that may reach using single diode laser. In most cases, a radiation zone is smaller than 3 micrometers.
[0069] What is necessary is just to take the principle of classic optics into consideration in calculation of the size of the spot of the laser beam which doubled the focus by this method. In fact, since the beam is restricted by diffraction, the size of a spot is larger than the value calculated by this method.
[0070] It is better not to use in practice the scale factor which determined the size of a spot using the principle of the gauss restricted by diffraction, and was calculated by the formula of a classic lens. In **, this is more possible than the size of the spot by which the size of the spot calculated using the formula of a lens was calculated using the theory over the beam of the shape of a Gaussian curve restricted by diffraction, only when small. This means that must be small as much as possible as for Lf, and it must be preferably smaller than 20 micrometers. Because, [0071]
[Equation 4]

$$Le = Lf * \frac{v}{b}$$

$$Lf = Le * \frac{b}{v}$$

[0072] Since Le is restricted to 3 micrometers and b is restricted to 600mm, only possibility of acquiring the small value of Lf is making v increase.
[0073] In order to reach the size of the theoretical spot of 20 micrometers, the distance v between a lens and laser must be at least 90mm, as shown in the following formula.
[0074]
[Equation 5]

$$v = \frac{Le}{Lf} * b$$

$$v = \frac{3}{20} * 600$$

$$v = 90mm$$

[0075] However, in at least 90mm distance, very much light is lost and optical efficiency becomes low.
[0076] It is calculated by optical efficiency being 10 degrees and emission of one direction assuming it that emission of other directions is 30 degrees.
[0077] The diameter of the laser beam in the place of a lens is 2x90xtg(30 degrees) =104mm in 2x90xtg(10 degrees) =32.7mm and other directions in the one above-mentioned direction.
[0078] Losses are 30 of a laser beam / 32.7= 92% in the one above-mentioned direction to a lens with a diameter of 30mm, and they are 30 / 104= 29% in other directions.
[0079] Therefore, the above-mentioned optical efficiency becomes 0.29x0.92=26%.
[0080] 50% of light is further lost for reflection in the front face of a lens and a mirror. Therefore, the optical efficiency acquired is 26%x0.5=13%. In order to obtain 15mW in the place of the screen of a phosphor which can be stimulated with light in above equipment, the radiation outputs of laser must be 15 / 0.13= 115mW.
[0081] The laser diode with such an output cannot be easily obtained at a proper price.
[0082] When [when using a BaFBr:Eu phosphor therefore] not allowing excessive loss of optical efficiency, the size of the minimum spot obtained can be calculated by the following formula.
[0083]
[Equation 6]

$$Le = Lf * (v/b)$$

$$Lf = Le * (b/v)$$

[0084] Le is limited to 3 micrometers (the minimum value acquired as a radiation zone of diode laser), b is equal to 600mm (the minimum distance between the lens toward which the spot of laser can be biased along with the scanning line with a length of 400mm, and the screen of a phosphor), and v is equal to 26mm (the minimum distance between the laser for collecting all the light of laser, and a lens).
[0085] The theoretical minimum values of Lf are 3x600 / 26= 69.2 micrometers.
[0086] In fact, probably the behavior of optical system will be not ideal (for example, smoothness to which the mirror for biasing gauss-like average rhe SHON (aberation) and light of a lens was restricted), and the size of a spot will be larger.
[0087] Moreover, the size of a spot will benefit large the limited effect of the shape of a gauss by diffraction.
[0088] The size of a spot is set to at least 100 micrometers, when using a BaFBr:Eu phosphor, if all these effects are taken into consideration.
[0089] If this invention is followed, this halogenide will use the screen of a phosphor which can be stimulated with the light which is at least one sort of a chloride or a bromide including the halogenation caesium by which activation was carried out with divalent europium.
[0090] The screen of the phosphor containing the divalent halogenation caesium of the most desirable above-mentioned needlelike type is used. For this needlelike type phosphorus, a peculiar SWR value is per [3] mm. In lp, it is 0.6-0.65. This reads and the SWR value of equipment is per [3] mm. It is [about 0.7 or] per [5] mm to lp. It means that it must be 0.5 to lp.
[0091] Such an SWR value is acquired when the focus is doubled until a laser beam becomes the spot which is 50 micrometers. (This diameter is the value measured between 1 of the profile of the shape of a gauss of a laser beam / point of e2.)
[0092]
[Measuring method] In order to opt for the minimum laser output required for read-out equipment, Parameter Se is defined in the zone of 2 1mm as an amount of the energy of laser required to emit 63% of the energy saved as synchrotron orbital radiation.
[0093] The output of required laser is given by the following formula.
[0094]
[Equation 7]

$$Pl = Se * Area\_IP / T$$

[0095] Pl is the output of laser here. Area_IP expresses the whole surface product of the picture board with which read-out is performed, and T expresses the amount of all times required to read the screen of a phosphor which can be stimulated with light.
[0096] The output Pl of laser is proportional to Se.
[0097] To a BaFBr:Eu phosphor, it is value =17microJ/mm2 of Se.
[0098] To CsBr:Eu of this invention, it is value =6microJ/mm2 of Se.
[0099] Therefore, in order for the output of required laser to obtain an equivalent result in the front face of the screen of the phosphor in the case of a CsBr:Eu phosphor, it is 6/17 of the output of laser required in the case of a BaFBr:Eu phosphor.
[0100] Although the 15mW output was required on the screen in the case of the BaFBr:Eu phosphor, in the case of a CsBr:Eu phosphor, about 5mW is slightly required on a screen.
[0101] According to the experiment, it was shown that read-out of a screen can be performed within the time permitted at least 2mW (output value on a screen).
[0102] Therefore, if this phosphor is used, though the laser of a low output can be used and optical efficiency will become low by optimization, the size of a small laser spot can be used (therefore, high resolution is obtained).
[0103] Moreover, if this phosphor is used, it can be made to operate using an object distance shorter (for example, to refer to 26mm and the above) than 30mm.
[0104] The example of 1 embodiment of the equipment of this invention is shown in drawing 3 .
[0105] Read-out equipment is the light source (5) which gives a stimulus, especially Spectra. Diode The SDL-7601-V1 type laser diode of Labs is included. Laser emits 680nm light and an optical output is 10mW. The size of a radiation zone is 3micrometerx1micrometer.
[0106] This equipment possesses guidance (8) of the light for guiding the mirror (12) in which it vibrates for biasing the direction of the light further emitted on the lens system (11) and the screen (7) of the phosphor which may be stimulated with light by the laser light source which gives a stimulus, and the light which the screen of a phosphor which can be stimulated with light emits on a photo multiplier (9) in response to a stimulus of light.
[0107] Read-out equipment contains the equipment (not shown) made to move the screen of a phosphor which can be further stimulated with light to the secondary scanning direction of an arrow (10).
[0108] This lens system is arranged so that the distance from which object distance produces 90mm and an image may be set to 600mm.
[0109] The main features and modes of this invention are as follows.
[0110] 1. In Method of Reading Picture of Light Saved on Screen of Phosphor Which Can be Stimulated with Light - It Scans by Stimulus Light to which this Screen was Emitted by Laser Light Source. - Light Emitted by this Screen in response to Stimulus is Detected, and it is -. It Consists of Process in Which Detected Light is Changed into Electrical Signal Expression of Picture of this

Light. Under the present circumstances, - The screen of a phosphor which can be stimulated with light consists of the phosphor of the halogenation caesium by which activation was carried out with divalent europium. This halogenide is at least one sort of a chloride and a bromide. - How to double the focus of this laser beam so that the diameter of the laser spot emitted from this laser may measure between 1 of the profile of the shape of a gauss of this laser beam / point of e2 and may become smaller than 100 micrometers.

[0111] 2. The diameter of this spot is a method given [smaller than 50 micrometers / above-mentioned] in the 1st term.

[0112] 3. This Phosphor is the Following Process, I.e., -. CsX EuX'2, EuX'3, and EuOX', However, X' shall be chosen from the group which consists of F, Cl, Br, and I. since -- 10-3-5-mol% of the europium compound chosen from the group which changes -- mixing - this mixture -- temperature higher than 450 degrees C -- calcinating - this mixture -- cooling - Method given above-mentioned] in the 1st term obtained according to the process which collects CsX:Eu phosphors.

[0113] 4. Screen of this Phosphor is the Following Process, I.e., -. CsX, and this EuX'2, EuX'3 and EuOX', However, X' is a halogenide chosen from the group which consists of F, Cl, Br, and I. This CsX:Eu phosphor is built by calcinating 10-3-5-mol % of the mixture of the europium compound chosen from the group which changes. since -- - Method given [above-mentioned] in the 1st term built by the process which covers this phosphor with the method chosen from the group which consists of a physical vapor deposition, a thermal vacuum deposition, a chemical vapor deposition, RF precipitator method, and pulse laser precipitator method to a substrate.

[0114] 5. This Phosphor is the Following Process, I.e., -. This CsX and EuX'2, EuX'3, and EuOX', However, X' puts the multiplex container of the europium compound chosen from the group which changes since it is chosen out of the group which consists of F, Cl, Br, and I on the bottom of a vacuum evaporationo condition. - By Method Chosen from Group Which Consists of Physical Vapor Deposition, Thermal Vacuum Deposition, Chemical Vapor Deposition, Electron Beam Precipitator Method, RF Precipitator Method, and Pulse Laser Precipitator Method The method given [above-mentioned] in the 1st term obtained according to the process which carries out self-possessed [of both these CsX(s) and these europium compounds] on a substrate at a rate which CsX by which 10-3-5 mol % of europium compounds was doped produces on a substrate.

[0115] 6. In Optical Picture Read-out Equipment for Reading Picture of Light Saved on Screen of Phosphor Which Can be Stimulated with Light - Light Source of Light Which Gives Stimulus, - Equipment with which Focus of Light Emitted by Light Source of Light Which Gives this Stimulus is Doubled, - Equipment toward which the Direction of Light Emitted by Light Source of Light Which Gives this Stimulus is Biased, - Light Emitted by Light Source of Light Which Gives this Stimulus by the Ability Giving Stimulus is Detected. The equipment which changes the light emitted by the ability giving this stimulus to electrical signal expression is provided. It is - here. The screen of this phosphor contains the halogenation caesium by which activation was carried out with divalent europium. This halogenide is at least one sort of a chloride or a bromide, and is -. The equipment with which the focus of the light emitted by the light source of the light which gives a stimulus is doubled Optical picture read-out equipment arranged so that the diameter of the spot of the beam of the light emitted by the light source of the light which gives a stimulus may measure between 1 of the profile of the shape of a gauss of this beam / point of e2 and may become smaller than 100 micrometers.

[0116] 7. The equipment with which the focus of the light emitted by the light source of the light which gives a stimulus is doubled is optical picture read-out equipment given [above-mentioned] in the 6th term arranged so that the diameter of the spot of the beam of the light emitted by the light source of the light which gives a stimulus may measure between 1 of the profile of the shape of a gauss of this beam / point of e2 and may become smaller than 50 micrometers.

[0117] 8. The equipment with which the focus of the light emitted by the light source of the light which gives this stimulus is doubled is optical picture read-out equipment given [above-mentioned] in the 6th term which contains the arrangement **** lens system so that object distance may become smaller than 30mm.

[0118] 9. Optical picture read-out equipment given [above-mentioned] in the 6th term arranged so that optical output of light emitted by the light source of light which gives this stimulus may become smaller than 5mW in place of screen.

[Translation done.]